

ESTABLISHMENT OF GUYMON BERMUDAGRASS,
CYNODON DACTYLON, (L.) PERS.
BY SEED

By
BOBBY GENE EDNEY
Bachelor of Science
Texas A. & M. University
College Station, Texas
1961

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Thesis approved:

Michael Smith
Thesis Adviser

Robert W. Morrison

Charles M. Salafino

Michael P. Kenna

Norman N. Durham
Dean of the Graduate College

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Abstract

A field study was conducted on 'Guymon' bermudagrass, Cynodon dactylon (L) Pers. seed to determine the effects of seeding rate, seed hulls, and mulch on establishment. The study contained four seeding rates, hulled and unhulled seed, and was planted with and without a fiber mulch cover. Seedling and shoot counts; shoot, root, and clipping dry weights; and percent ground cover were evaluated. Seed hulls delayed germination, seedling growth from date of emergence, and the establishment of ground cover. Seeding rates of 24,000 to 96,000 hulled seed/m² produced an 85% ground cover in 14 weeks. Hulled seed also produced higher seedling and shoot counts, shoot, root, and clipping dry weights. Unhulled seed produced an 85% ground cover in 18 weeks when seeded at 6,000 or 24,000 seed/m². The effects of mulch were minimal and may have been negated by the watering scheme during establishment. Nitrogen, potassium, and zinc concentrations in the bermudagrass were below published sufficiency ranges five weeks after planting. Crabgrass germinated within two days after bermudagrass was seeded,

and may have reduced bermudagrass growth prior to
crabgrass control by monosodium methanearsonate (MSMA).

INTRODUCTION

Introduced into the United States in the mid 1700's, bermudagrass is the most prevalent pasture and turfgrass in the temperate zone today. Cultivars vary in use from forage production ('Coastal', 'Midland', 'Hardie', etc.) to lawns, fairways, sportfields and parks ('Texturf-10', 'Sunturf', 'U-3', etc.). Maintenance varies from highly intensive such as that practiced on golf course greens and tees ('Tifgreen', 'Tifway', 'Pee De'e', etc.) to minimal maintenance.

Bermudagrass may be propagated by either seed or vegetative parts. Due to low seed production most bermuda cultivars are propagated vegetatively as plugs, sprigs or sod. Bermudagrass spreads rapidly by stolons and/or rhizomes under warm, moist and fertile conditions. It also survives well under dry conditions with low fertilization.

Common bermudagrass, variety unstated, is the most widely used seeded type. This type is commonly known as 'Arizona Common'. 'Guymon' bermudagrass, released by Oklahoma State University in 1982, is a relatively new seeded cultivar and the subject of this study (1). The 'Guymon' cultivar is derived from the interpollination of the cross-compatible, self-incompatible clonal bermudagrass accessions '12156' collected from Guymon,

Oklahoma, and '9959' introduced from Yugoslavia. The outstanding feature of 'Guymon' relative to 'Arizona common' is its substantially greater cold hardiness. 'Arizona common' is superior to 'Guymon' in morphological uniformity, fineness of texture and growth during establishment phase.

Seeding of bermudagrass is primarily attractive because of its relative low cost, however, it has met with mixed success (1). Where rapid establishment with minimum weed competition is desired, rates of approximately 20 to 30 thousand viable seeds/m² are suggested (2). This is a general recommendation for all , cool and warm season seeded turfgrasses. Recommended seeding rates for hulled bermudagrass seed varies from 5 to 10 g/m² (1 to 2 lbs/1,000 ft²) (4). These rates are expected to provide a ground cover of not less than 85% in one growing season. Lower and higher seeding rates have respective inherent disadvantages of excessive weed competition and weak, spindly seedlings that are susceptible to diseases, resulting in lower ground cover percentages (4). If a more rapid ground cover is desired, then sprigs or sod is recommended.

Ahring and Todd (3) found that hulled seeds germinate faster than unhulled seeds. In general, germination at the 7-day count was significantly greater for hulled than for unhulled seed. While hulled seed germinated faster,

after 28 days strain 9959's hulled and unhulled germination was not significantly different.

Mulch is used to create a barrier to heat or water vapor transfer (4). Mulches vary from natural materials such as dust, weeds or trash, stubble, and straw, to manufactured mulches such as aluminum foil, gravel, plastics, and paper. Barkley et al. (5) found that straw, sawdust, and wood fiber cellulose aids in turf establishment and moderates soil temperature.

The focus of this study is the establishment phase of seeded bermudagrass propagation. The primary objective of this field experiment was to determine the effects of seeding rates, mulch and seed hulls on establishment of 'Guymon' bermudagrass.

MATERIALS AND METHODS

A field experiment was conducted at the Oklahoma Turfgrass Research Center on a site which had a Kirkland Silt Loam soil greater soil series. Three weeks prior to planting, N-(phosphonomethyl)glycine, (glyphosate), was applied at 1.5 kg ai/ha to eliminate all vegetation. Two days prior to planting, the plots were disked to a depth of 15 cm, then rototilled to a depth of 5 cm. Finally, the site was leveled with a spike tooth, sectional harrow. An inorganic starter fertilizer (20-29-5) was applied at a rate of 98 kg of N/ha.

The study contained sixteen treatments using a factorial treatment combination with four seeding rates, and hulled and unhulled seed, either with or without mulch cover (Table 1). The study was laid out as a randomized complete block design with three replications.

The 'Guymon' bermudagrass unhulled seed (Lot K-4060-10611B) was provided by Johnston Seed Company of Enid, Oklahoma. It was produced in Oklahoma and tested for purity and germination in February 1986. The hulled seed was then processed by the company from this lot.

The four seeding rates were 1.2, 4.9, 9.8, and 19.5 g PLS/m². Percent pure live seed (PLS) was determined for hulled and unhulled seed (83.96 and 81.45%, respectively). In order to assure that response variables reflected the

true effect of hulled or unhulled seed, instead of seed numbers, the four seeding rates were adjusted to a pure live seed count (PLSC) basis. Six 1000 seed count samples of hulled and unhulled seed were obtained using an Old Mill Company Electronic Counter, Savage, MD. Averages based on six 1000 seed weights were calculated for hulled and unhulled seed (0.214g and 0.366g, respectively). The seeding rate for hulled seed was then converted to a PLSC basis (i.e., number PLS/m²) using the average 1000 seed weight, and resulted in 6, 12, 48, and 96 thousand PLS/m². The number of PLS/m² for hulled seed was used to determine the g PLS/m² for unhulled seed which placed the two seed types on an equal PLSC basis.

Oklahoma's varying wind velocities required the use of a wind screen to prevent uneven seed distribution during planting. Hand seeding via pint shaker jars was selected due to the small volume of seed in each package. Corn meal was added to the hulled seed in order to obtain a visual sign of the coverage. All replications were seeded and raked into the soil at 3 to 6 mm depth for incorporation and good soil contact.

The mulch was ECKROAT'S ORIGINAL wood cellulose fiber mulch obtained from Eckroat Seed Co., Oklahoma City, Oklahoma (6). It is a virgin fiber produced from a blend of hardwood and pine. The wood is cooked, screened, washed, and dried to produce a fiber with few resins or other growth inhibiting factors. The fiber contains no

weed seeds or other such contaminants. A water soluble, non-toxic dye was added during the manufacturing process to provide a visual guide for uniform application. It has an 8.0 pH (+ or - 0.5), a water holding capacity of 800g/100g, and an ash content (calcium carbonate) of 10% (dry basis). Fiber dimensions are 64% on 20 mesh, 15% on 65 mesh, 5% on 150 mesh and 16% through th 150 mesh. Mulch was weighed and hand distributed using a planting frame. It was applied to the surface at a rate of 1814 kg/ha. The entire study was then rolled and irrigated by rotary sprinklers.

Initial maintenance of the experimental area consisted of irrigation only. The top 1 to 2 cm of soil were kept moist for the first four weeks by watering every one to two days. The first mowing was the third week after planting. The bermudagrass was still in the seedling stage with no stolons or rhizomes. The crabgrass, however, was extremely vigorous, therefore, mowing was used to control crabgrass growth and reduce shading of the bermudagrass. Mowing was conducted weekly thereafter.

MSMA at 92 g ai/ha was applied during the sixth week (fifth week after seedling appearance) and again at 184 g ai/ha rate during the seventh week. No visual damage was detected on the bermuda after either application. The crabgrass was eliminated the 10th week following a third MSMA application at full rate.

Response variables included seedling and shoot counts, and shoot and root weights for three subsamples from each plot. Elemental concentrations (N, P, K, Ca, Mg, Mn, Fe, and Zn) were analyzed once on both bermuda and crabgrass foilage. Clippings weights were determined from a 20% area collected from each plot. Visual ratings of percent cover were determined for the entire plot.

The first response variable evaluated was the number of seedlings. Three 10 cm diameter rings were randomly tossed on each plot and the seedlings inside the ring were counted. These ratings were taken the second through the fifth weeks after planting. The rings were also randomly tossed to determine the location to harvest plants and roots. Three cylindrical plugs 10 cm in diameter and 10 cm in depth were harvested 7, 10, and 13 weeks after planting. The day prior to plug harvesting the study was watered thoroughly. After the plugs were harvested they were saturated with water and allowed to soak for one hour. Each plug was then washed using a U.S. Standard Sieve 20 mesh screen to retain the plants, and a gentle spray was applied to separate individual plants and roots. Bermudagrass was separated and the remaining weedy plants were discarded. Seedlings (i.e., plants) and their shoots were then counted and separated from their roots at the crown. Plant and shoots were placed in one bag and the roots in another. They were dried at 92°C for 72 hours, then immediately weighed.

Clipping weights were determined for weeks 10 through 16. Twenty percent of each plot area was mowed (harvested) at a 1.3 cm cutting height with a McClain mower. The clippings were bagged and dried for 72 hours at 92°C. They were then removed and weighed immediately using a Sartorius GMBH 600/60,000 g Type 1419 MPB-1 electronic scale.

Elemental analysis was conducted on both bermudagrass and crabgrass. Foliage from 20% of each plot was clipped at 1.3 cm and pooled across seeding rates. Cut foliage was stored on ice to reduce wilting until after washing. Bermudagrass and crabgrass were separated, washed in a liquinox solution, followed by 0.1N HCl, then two deionized water rinses and oven dried at 75°C. The samples were then ground through a 20 mesh screen using a Wiley mill and stored in capped, air-tight jars until the time of analysis. The samples were analyzed using standard methods for nitrogen by macro-Kjeldahl, phosphorous by colorimetrics, and other elements by atomic absorption spectroscopy.

Percent ground cover was rated during the 12, 14, 16, and 18 week after planting. First the entire experiment was scanned visually to obtain an overall perspective (visual calibration) as well as to determine the treatments with the highest and lowest ground cover percentages. Starting with replication one and always approaching from the same direction, each treatment was

evaluated in field layout order. Once completed, the order was reversed and each treatment re-evaluated. Scores were then compared and averaged; however, treatments with a difference of more than ten percentage points received a third evaluation before averaging. The same individual conducted all observations.

Statistical analysis consisted of an ANOVA of response variable means for each treatment on individual observation dates. Interaction among response variables was not evaluated.

RESULTS AND DISCUSSION

Seedlings began to emerge five days after seeding, and seedling counts were made weeks 2 through 5 after planting. Significant variation among seeding rates occurred for all sampling dates and for hulled and unhulled seed. The hulled seed treatment produced higher seedling counts than unhulled seed (Table 2). Seedling counts decreased between weeks 3 and 4 for the three higher seeding rates. However, the lowest seeding rate did not demonstrate this trend. The unhulled seed treatment also produced higher seedling counts for the higher seeding rates; however, that difference was not significant in week 5. Large decreases in seedling survival of the two higher seeding rates occurred between weeks 3 and 4. Hulled seed produced more seedlings than unhulled seed.

The shoot count (shoots/m²) was made during the 7, 10, and 13 weeks after planting. There was a significant interaction between the hulled and unhulled seed treatments for shoot counts (Table 3). There was significant variation in the number of shoots among seeding rates for hulled and unhulled seed for all sampling dates. For hulled seed, higher shoot counts occurred for the three higher seed rates. However, the differences diminished 13 weeks after planting. In contrast, the unhulled seed treatment reflected higher

shoot counts for the intermediate seeding rates (i.e., 24 and 48 thousand seed/m²) by week 13. The hulled seed treatment had higher shoot counts overall than unhulled seed treatment. Higher shoot counts occurred for the higher seeding rates and hulled seed treatments (Table 3).

Root and shoot weight response variables were examined in weeks 7, 10, and 13. The dry root weight showed a significant interaction between seed type and seed rate (Table 4). Seedling from hulled seed continuously increased root weights (with each incremental increase in seeding rate); whereas, seedling dry root weights of the unhulled seed began to decrease during week 10. The hulled seed also produced significantly higher shoot weights than the unhulled seed (Table 5).

The lack of a significant difference in the effects of mulch could have been due to cultural practices. All treatments were watered according to the needs of the unmulched bare soil, thereby, negating the primary benefit of mulch. This was especially critical during the early seedling stage. As the growing season progressed, water was applied weekly which may account for the lack of a significant difference among treatments.

Bermudagrass foliar elemental analysis revealed no significant variation among treatments (Tables 6 and 7). However, when compared to sufficiency data developed for coastal bermudagrass by the University of Georgia (7), nitrogen, potassium, and zinc were below recommended

concentrations. There was a significant difference between bermudagrass and crabgrass concentrations for all elements tested.

Clipping dry weights differed significantly between hulled and unhulled seed for weeks 12 through 15 (Table 8). Hulled seed clipping dry weights were greater than clippings of unhulled seed for weeks 13 and 14 only. The unhulled seed had a higher clipping weight than hulled seed during week 12.

Percent ground cover varied significantly for hulled and unhulled seed treatments for all seeding rates over time. The highest three seeding rates of hulled seed had a larger percent ground cover than the same rates of unhulled seed (Table 9). In contrast, unhulled seed's three lower seeding rates had the higher percent ground cover than its highest seeding rate. Hulled seed reached an acceptable level of ground cover (i.e., greater than 85%) 4 weeks earlier than unhulled seed.

CONCLUSION

Establishment of a bermudagrass turf from seed in 12 to 14 weeks can be achieved. The highest hulled seed seeding rate (96,000 seed/m²) achieved an 85% ground cover by week 12, whereas, the three highest seeding rates achieved an 85% ground cover by week 14. All hulled seed seeding rates established a 85% ground cover earlier than unhulled seed. The lack of a significant difference in ground cover among the three higher hulled seeding rates indicates that the 24,000 seed/m² (1 lb/m²) seeding rate would be the most economical.

The difference between the hulled and unhulled seed in the development of a ground cover may be attributed to the earlier germination of the hulled seed and the possibility of growth retarding substance (s) in the seed coats of unhulled seed (5). Also the contrasting higher performance of the two lower seeding rates of unhulled seed appears to support this premise. Seedling and shoot counts as well as root and shoot weights generally followed this same trend.

Both hulled and unhulled seed exhibited a significant decrease in seedling counts between weeks 3 and 4 after planting. With unhulled seed this phenomenon becomes more acute as seeding rate increases from 24,000 to 96,000 seed/m² and results in no detectable differences in

seedling counts by 5 weeks after planting. This development could be attributed to seed coats, crabgrass competition, seeding rate (i.e., over population), and/or nutrient deficiencies in nitrogen, potassium, and zinc found during the fifth week.

The effects of early crabgrass competition appears to have been significant. As depicted in the chemical analysis, crabgrasses is a tough competitor. Crabgrass emerged 3 days after planting and was significantly larger than the bermuda seedlings until controlled by MSMA. Earlier application of MSMA (3 weeks after emergence of the bermuda, according to the label) was not attempted due to the weak appearance of the bermudagrass seedlings. A pre-emergence herbicide was not applied, since the bermudagrass seedlings would have been affected as well.

In summary, the rate of 'Guymon' bermudagrass turf established from seed will be affected by seed type (hulled or unhulled) as well as seeding rate. A 24,000 seed/m² hulled seed seeding rate is sufficient to obtain an 85% ground cover in 14 weeks. This percent ground cover can be achieved two weeks earlier by increasing the hulled seed seeding rate to 96,000 seed/m²; however, the economics of this rate must be considered. Unhulled seed germinated and grew slower, however, a 6,000 seed/m² approached an 85% ground cover in 18 weeks.

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Table I. Seeding rate, seed type, and
mulch treatments investigated

No. of PLS Seed	Seed type	Mulch

---No./m ² ----		
6,000	Hulled	Yes
24,000	Hulled	Yes
48,000	Hulled	Yes
96,000	Hulled	Yes
6,000	Unhulled	Yes
24,000	Unhulled	Yes
48,000	Unhulled	Yes
96,000	Unhulled	Yes
6,000	Hulled	No
24,000	Hulled	No
48,000	Hulled	No
96,000	Hulled	No
6,000	Unhulled	No
24,000	Unhulled	No
48,000	Unhulled	No
96,000	Unhulled	No

Table II. Mean seedling counts, two through five weeks after planting, by seed type and seeding rate.

	Seedling Counts*			
Seeding rate	Week 2**	Week 3	Week 4	Week 5
	No./m ² (df=30)			
Hulled				
6000	404	610	575	452
24000	850	1953	1254	967
48000	1494	2900	1624	1289
96000	2749	4627	2159	1666
Unhulled				
6000	34	672	754	658
24000	260	1604	1515	932
48000	1295	3407	1384	1165
96000	2214	5511	1522	987
\bar{X}	1162	2659	1348	1014
LSD (0.05)	1136	1241	530	428
CV (%)	143	68	57	62

* Mean shoot count average of 18 observations

** Weeks after planting.

Table III. Mean shoot counts, 7, 10, and 13 weeks after planting, by seed type and seeding rate.

	Shoot Counts*		
Seeding rate	Week 7**	Week 10	Week 13
	No./m ² (df=30)		
Hulled			
6000	2125	4941	8082
24000	4085	6821	9989
48000	4168	8151	11380
96000	7404	10365	11853
Unhulled			
6000	1617	4936	5553
24000	2659	4977	7506
48000	2989	4100	6012
96000	1673	3482	4963
\bar{X}	3339	5977	8165
LSD (0.05)	1777	601	648
CV (%)	78	47	54

* Mean shoot count average of 18 observations

** Weeks after planting.

Table IV. Mean root weights, 7, 10, and 13 weeks after planting, by seed type.

	Root Weights*		
Seed type	Week 2**	Week 3	Week 4
	g/m ² (df=30)		
Hulled			
6000	11.91	23.67	36.86
24000	23.87	35.45	38.53
48000	25.98	46.56	54.90
96000	40.63	65.07	52.89
Unhulled			
6000	7.35	21.89	16.27
24000	12.76	29.72	24.73
48000	13.42	23.82	17.62
96000	7.64	23.59	12.66
\bar{X}	17.94	33.70	31.79
LSD (0.05)	4.35	7.12	8.08
CV (%)	72	63	76

* Mean root weights average of 18 observations

** Weeks after planting

Table V. Mean shoot weights, 7, 10, and 13 weeks after planting, by seed type.

Seed type	Shoot Weights*		
	Week 7**	Week 10	Week 13
	g/m ² (df=30)		
Hulled			
6000	31.78	139.91	122.39
24000	60.63	176.82	166.48
48000	65.52	237.04	161.21
96000	98.88	281.47	136.43
Unhulled			
6000	15.08	116.68	71.49
24000	26.75	108.00	93.37
48000	32.02	86.97	55.71
96000	17.86	58.66	40.26
\bar{X}	43.54	151.33	105.87
LSD (0.05)	23.97	29.00	21.79
CV (%)	80	57	61

* Mean shoot weights average of 18 observations

** Weeks after planting

Table VI. Foliar macro-nutrient test results on Guymon
Bermuda and crabgrass five weeks after
planting.

Grass	Elements*				
	Mg	P	Ca	N	K
	% (df=2)				
Guymon	0.15	0.28	0.36	1.65	1.14
Crabgrass	0.31	0.38	0.74	1.91	2.10
\bar{X}	0.23	0.33	0.54	1.77	1.61
LSD (0.05)	0.03	0.03	0.06	0.17	0.51
CV (%)	33	16	31	11	40
Coastal**	0.1-0.25	0.23-0.40	0.25-0.50	2.0-2.6	1.2-2.0

* Averaged of 12 observations

** Sufficiency data on coastal bermuda (2)

Table VII. Foliar micro-nutrient test results on Guymon bermuda and crabgrass five weeks after planting.

Grass	Elements*		
	Zn	Mn	Fe
	mg/kg (df=2)		
Guymon	18.67	37.58	124.67
Crabgrass	30.25	53.00	195.67
\bar{X}	24.45	45.29	160.17
LSD (0.05)	4.74	10.56	248.65
CV (%)	28	31	98
Coastal	20-70	20-300	50-200

* Averaged of 12 observations

** Sufficiency data on coastal bermuda (2)

Table VIII. Mean clipping weights, 10, 12, 13, 14, 15, and 16 weeks after planting, by seed type.

Seed type	Clipping Weights*					
	Weeks 10**	12	13	14	15	16
	g/m ² (df=30)					
Hulled	0.98	0.96	0.73	0.54	0.24	0.15
Unhulled	1.00	1.41	0.42	0.38	0.14	0.09
\bar{X}	0.99	1.18	0.57	0.46	0.19	0.12
LSD (0.05)	0.11	0.27	0.19	0.15	0.10	0.09
CV (%)	18	39	55	55	84	112

* Mean clipping weights average of 24 observations

** Weeks after planting

Table IX. Percent cover, weeks 12, 14, 16, and 18 after planting, by seed type and seeding rate.

	Percent Cover*			
Seeding rate	Week 12**	Week 14	Week 16	Week 18
---No/m ² ---	----- % (df=30) -----			
Hulled				
6000	57.5	67.5	84.7	88.5
24000	75.8	86.7	92.7	96.2
48000	80.8	90.8	94.7	96.8
96000	85.0	89.2	95.3	97.0
Unhulled				
6000	43.3	63.3	80.0	83.3
24000	35.8	64.2	75.8	85.5
48000	30.8	57.5	69.2	76.7
96000	15.0	35.8	59.2	55.0
\bar{X}	53.0	69.4	81.4	84.9
LSD (0.05)	9.8	7.9	7.8	8.0
CV (%)	22	13	11	10

* Mean of visual ratings average of 6 observations

** Weeks after planting

VITA 2

Bobby G. Edney

Candidate for the Degree of
Master of Science

Thesis: ESTABLISHMENT OF GUYMON BERMUDAGRASS, CYNODON
DACTYLON, (L.) PERS. BY SEED

Major Field: Horticulture

Biographical:

Personal Data: Born in Kilgore, Texas, May 16, 1939,
the son of Roy and Lera A. Edney.

Education: Graduated from Kilgore Senior High
School, Kilgore, Texas, in May 1957; received
Bachelor of Science in Agriculture from Texas
Agriculture and Mechanical University in August
1961; completed requirements for the Master of
Science degree at Oklahoma State University in
May, 1988.

Professional: Officer, United States Air Force,
November 1962 to December 1984.